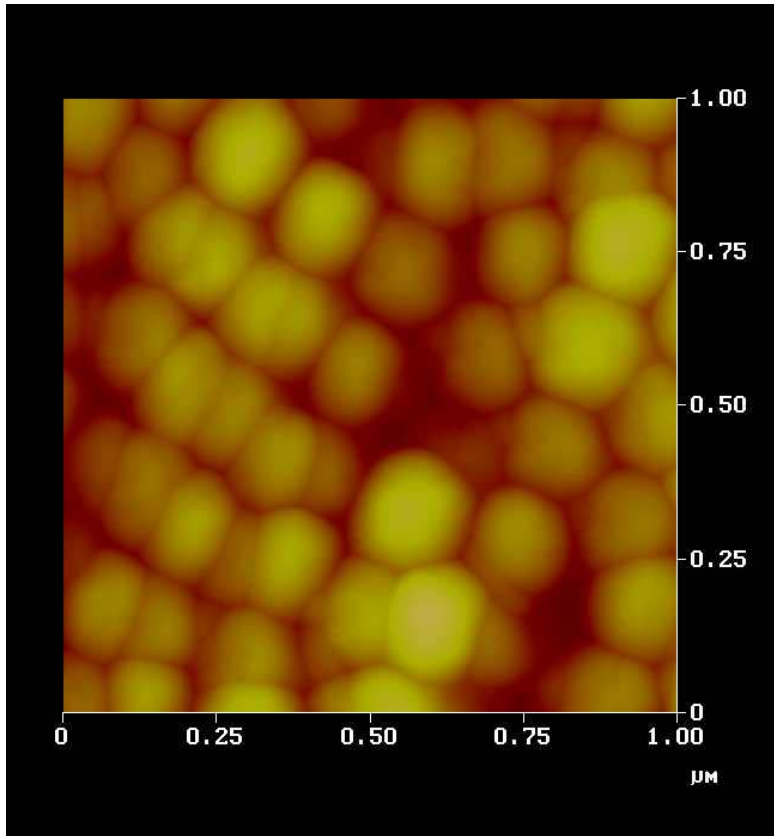
Organic Nanoparticles

Ed Van Keuren, Georgetown University, DMR-0348955

In our studies of the self-assembly of organic molecules to form nanoparticles, we have developed a new way of synthesizing polymer nanoparticles. The polymer building blocks , monomers, are first induced to self-assemble, after which they are polymerized. The self-assembly can be precisely controlled to yield a narrow range of particle sizes. We have also combined the results of several different optical techniques to confirm a model of how these particles grow - initially by diffusion of molecules to the surface, later by aggregation of smaller particles.



AFM image of polymer nanoparticles created with solvent shifting.

Who: Professor Edward Van Keuren

Where: Department of Physics, Georgetown University, Washington DC

What: Investigations of nanoparticle formation and growth using several optical characterization methods. The nanoparticles are synthesized using solvent shifting, a wet-chemical method in which molecular self-assembly is induced by adding a miscible non-solvent to a solution. The non-solvent lowers the solubility of the solute, causing the particles to form and grow. The focus of my research is gaining an understanding of how these particles grow, but by tweaking the processing and chemistry, we can also synthesize stable nanoparticles and use them in a number of applications.

So What?. This process is connected to a variety of areas in biology and chemistry, such as crystal formation and biomineralization, and understanding will help either prevent (e.g. in gallstones) or promote (nonlinear optical crystals) the formation of the particles. We are also looking at applications in synthesizing nanoparticle formulations of water-insoluble drugs.

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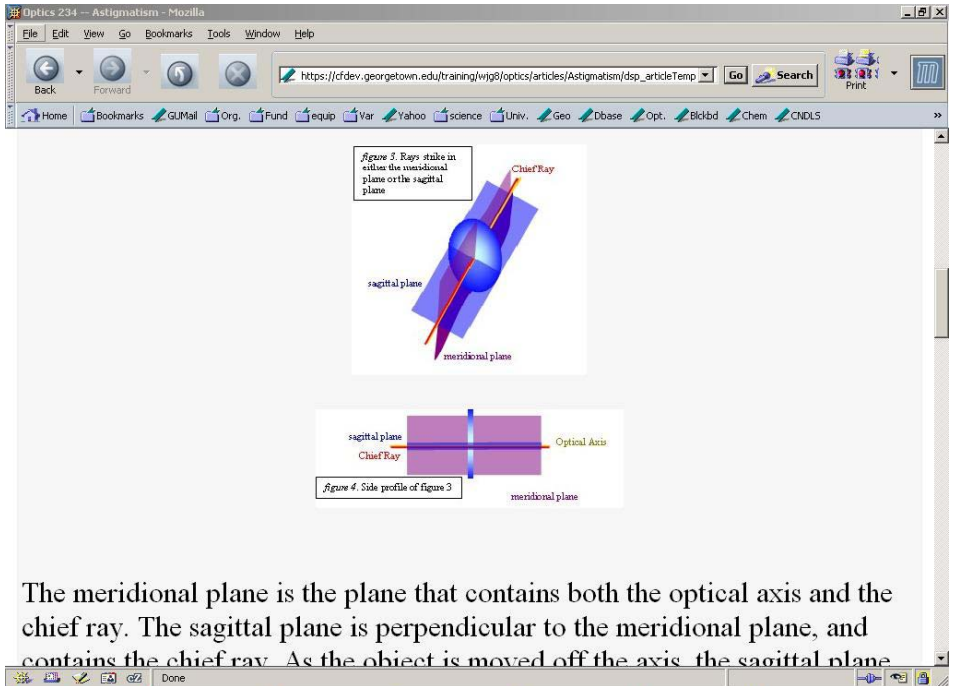
Four undergraduate (David Littlejohn, Maki Nishida, Nicholas Malaya and Gregory Nelson) and three graduate (Kristen Bloschock, Changbao Ma and Nadjib Benatmane) researchers played substantial roles in the study of the formation of organic nanoparticles. Bloschock has recently won a full fellowship from the ARCS foundation, and Ma won a Young Scholars Award from the Cosmos Club Foundation.

We are also developing a novel online optics reference book for undergraduate optics. This reference book has several innovative features, including distributed authorship and the use of active learning by undergraduates in the creation and revision of the material and the delivery of multiple levels of content.



Screen shot of portion of webtext developed by undergraduate students

Who: Professor Edward Van Keuren

Where: Department of Physics, Georgetown University, Washington DC

What: The webtext is a project to generate a living, online reference text for upper level optics. This reference book will have several innovative features, including distributed authorship and the use of active learning by undergraduates in the creation and revision of the material and the delivery of multiple levels of content.

So What: Upper level undergraduate and graduate courses are difficult to develop due to the limited selection of course material at the appropriate level. As a result, there are likely to be topics the instructor feels are important for which additional reference material is inadequate or nonexistent. This problem is partly due to the fact that books are written by one or a few people, and so reflect their particular preferences, understanding of specific topics and so on. The webtext will be a publicly available site that covers a wide range of optics topics, and similar to the recently popular "Wikipedia" will be a collaborative effort, containing descriptions optimized through many revisions by many people.